Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

**Amendments to the Claims**

This listing of claims will replace all prior versions, and listings, of claims in the application:

1.  (Canceled)

2.  (Currently Amended)  The apparatus of claim $\underline{5}$ [[1]] wherein the red, green, blue and infrared intensity information are captured substantially contemporaneously.

3.  (Currently Amended)  The apparatus of claim $\underline{5}$ [[1]] further comprising:

a red pixel buffer coupled with the interpolation unit to store red intensity data;

a green pixel buffer coupled with the interpolation unit to store green intensity data;

a blue pixel buffer coupled with the interpolation unit to store blue intensity data; and

an infrared pixel buffer coupled with the interpolation unit to store infrared intensity data.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

4.    (Original)  The apparatus of claim 3 further comprising a signal processing unit coupled to the red pixel data buffer, the green pixel data buffer, the blue pixel data buffer and the infrared pixel data buffer.

5.    (Currently Amended)  An [[The]] apparatus of claim 1 comprising:

a sensor unit to capture wavelength intensity data for a plurality of pixel locations wherein the sensor generates a value corresponding to an intensity of light from a selected range of wavelengths for the pixel locations and further wherein infrared intensity values are generated for a subset of the pixel locations wherein the sensor unit captures intensity data according to a predetermined pattern comprising:

| B  | R | B   | R |
|----|---|-----|---|
| IR | G | IR  | G |
| B  | R | B   | R |
| IR | G | IR  | G |

where R indicates red intensity information, G indicates green intensity information, B indicates blue intensity information and IR indicates infrared intensity information; and

an interpolation unit coupled with the sensor unit to interpolate intensity data to estimate intensity values not generated by the sensor.

6.    (Original)  The apparatus of claim 5, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

-3-

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the green intensity corresponding to the

location (m,n) is given by

$$G = \dfrac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n-1) + X(m+1,n+1)}{4}$$, and the blue

intensity corresponding to the location (m,n) is given by $B = X(m,n)$.

 

      7.     (Original)  The apparatus of claim 5, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by

$$IR = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$$, the red intensity

corresponding to the location (m,n) is given by $R = X(m,n)$, the green intensity

corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the

blue intensity corresponding to the location (m,n) is given by

$$B = \dfrac{X(m,n-1) + X(m,n+1)}{2}.$$

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

8.      (Original)  The apparatus of claim 5, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m is an even integer and n is an odd integer, the infrared intensity corresponding to the location (m,n) is given by $IR = (m,n)$, the red intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$,

the green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, and the blue intensity corresponding to the location (m,n)

is given by $B = \dfrac{X(m-1,n) + X(m+1,n)}{2}$.


9.      (Original)  The apparatus of claim 5, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the green intensity corresponding to the

location (m,n) is given by $G = X(m,n)$, and the blue intensity corresponding to the

location (m,n) is given by

$B = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

10.    (Currently Amended)  An [[The]] apparatus of claim 1 comprising:

a sensor unit to capture wavelength intensity data for a plurality of pixel locations wherein the sensor generates a value corresponding to an intensity of light from a selected range of wavelengths for the pixel locations and further wherein infrared intensity values are generated for a subset of the pixel locations wherein the sensor unit captures intensity data according to a predetermined pattern comprising:

| IR | R  | IR | B  |
|----|----|----|----|
| G  | IR | G  | IR |
| IR | B  | IR | R  |
| G  | IR | G  | IR |

where R indicates red intensity information, G indicates green intensity information, B indicates blue intensity information and IR indicates infrared intensity information; and

an interpolation unit coupled with the sensor unit to interpolate intensity data to estimate intensity values not generated by the sensor.


11.    (Original)  The apparatus of claim 10, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = X(m,n)$, and the green intensity corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and further wherein if the pixel at location (m,n-

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

1) is red, the blue intensity corresponding to the location (m,n) is given by

$B = X(m, n+1)$ and the red intensity corresponding to the location (m,n) is given by

$R = X(m, n-1)$, and if the pixel at location (m,n-1) is blue, the red intensity

corresponding to the location (m,n) is given by $R = X(m, n+1)$ and the blue intensity

corresponding to the location (m,n) is given by $B = X(m, n-1)$.

 

12.    (Original) The apparatus of claim 10, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = \dfrac{X(m-1, n) + X(m+1, n) + X(m, n-1) + X(m, n+1)}{4}$ and

green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m-1, n-1) + X(m+1, n-1) + X(m-1, n+1) + X(m+1, n+1)}{4}$ and further wherein

if the pixel at location (m,n) is red, the blue intensity corresponding to the location (m,n)

is given by $B = \dfrac{X(m-2, n) + X(m+2, n) + X(m, n-2) + X(m, n+2)}{4}$ and the red

intensity corresponding to the location (m,n) is given by $R = X(m, n)$, and if the pixel at

location (m,n) is blue, the red intensity corresponding to the location (m,n) is given by

$B = X(m, n)$ and the blue intensity corresponding to the location (m,n) is given by

$R = \dfrac{X(m-2, n) + X(m+2, n) + X(m, n-2) + X(m, n+2)}{4}$.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

13.    (Original)  The apparatus of claim 10, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m is an even integer and n is an odd integer, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m,n-1) + X(m,n+1) + X(m-1,n) + X(m+1,n)}{4}$ and green intensity corresponding to the location (m,n) is given by $G = X(m,n)$ and further wherein if the pixel at location (m-1,n-1) is red, the blue intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m-1,n+1) + X(m+1,n-1)}{2}$ and the red intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m-1,n-1) + X(m+1,n+1)}{2}$, and if the pixel at location (m-1,n-1) is blue, the red intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m-1,n+1) + (m+1,n-1)}{2}$ and the blue intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m-1,n-1) + X(m+1,n+1)}{2}$.


14.    (Original)  The apparatus of claim 10, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both even integers, the infrared intensity corresponding to the location (m,n) is given by $IR = X(m,n)$, and the green intensity corresponding to the location (m,n) is

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

given by $G = \dfrac{X(m, n-1) + X(m, n+1)}{2}$ and further wherein if the pixel at location (m-

1,n) is red, the blue intensity corresponding to the location (m,n) is given by

$B = X(m+1, n)$ and the red intensity corresponding to the location (m,n) is given by

$R = X(m-1, n)$, and if the pixel at location (m-1,n+1) is blue, the red intensity

corresponding to the location (m,n) is given by $R = X(m+1, n)$ and the blue intensity

corresponding to the location (m,n) is given by $B = X(m-1, n)$.


15.     (Currently Amended) An [[The]] apparatus of claim 1 comprising:

a sensor unit to capture wavelength intensity data for a plurality of pixel locations

wherein the sensor generates a value corresponding to an intensity of light from a

selected range of wavelengths for the pixel locations and further wherein infrared

intensity values are generated for a subset of the pixel locations wherein the sensor unit

captures intensity data according to a predetermined pattern comprising:

| B | R | B | R |
|---|---|---|---|
| G | IR | G | IR |
| B | R | B | R |
| G | IR | G | IR |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information; and

an interpolation unit coupled with the sensor unit to interpolate intensity data to

estimate intensity values not generated by the sensor.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

16.    (Original) The apparatus of claim 15, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n+1) + X(m+1,n-1)}{4}$, the red intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the green intensity corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the blue intensity corresponding to the location (m,n) is given by $B = X(m,n)$.

17.    (Original) The apparatus of claim 15, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m is an odd integer and n is an even integer, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding to the location (m,n) is given by $R = X(m,n)$, the green intensity corresponding to the location (m,n) is given by

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

$$G = \frac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}, \text{ and the blue}$$

intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m,n-1) + X(m,n+1)}{2}$.

18. (Original) The apparatus of claim 15, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m is an even integer and n is an odd integer, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding to the location (m,n) is given by

$$R = \frac{X(m-1,n-1) + X(m+1,n-1) + X(m+1,n+1) + X(m+1,n-1)}{4}, \text{ the green intensity}$$

corresponding to the location (m,n) is given by $G = X(m,n)$, and the blue intensity

corresponding to the location (m,n) is given by $B = \dfrac{X(m-1,n) + X(m+1,n)}{2}$.

19. (Original) The apparatus of claim 15, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = X(m,n)$, the red intensity corresponding to the location (m,n) is given by

$$R = \frac{X(m-1,n) + X(m+1,n)}{2}, \text{ the green intensity corresponding to the location (m,n) is}$$

given by $G = \dfrac{X(m, n+1) + X(m, n-1)}{2}$, and the blue intensity corresponding to the

location (m,n) is given by

$$B = \frac{X(m-1, n-1) + X(m+1, n+1) + X(m-1, n+1) + X(m+1, n-1)}{4}.$$

20.　　　(Currently Amended) An [[The]] apparatus of claim 1 comprising:

a sensor unit to capture wavelength intensity data for a plurality of pixel locations

wherein the sensor generates a value corresponding to an intensity of light from a

selected range of wavelengths for the pixel locations and further wherein infrared

intensity values are generated for a subset of the pixel locations wherein the sensor unit

captures intensity data according to a predetermined pattern comprising:

| B | G | B | G[[B]] |
|---|---|---|---|
| IR | R | IR | R |
| B | G | B | G |
| IR | R | IR | R |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information; and

an interpolation unit coupled with the sensor unit to interpolate intensity data to

estimate intensity values not generated by the sensor.

21.　　　(Original) The apparatus of claim 20, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n+1) + X(m+1,n-1)}{4}$,

the green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, and the blue intensity corresponding to the location (m,n)

is given by $B = X(m,n)$.


22.    (Original)  The apparatus of claim 20, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by

$IR = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$, the red intensity

corresponding to the location (m,n) is given by $R = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the green

intensity corresponding to the location (m,n) is given by $G = X(m,n)$, and the blue

intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m,n-1) + X(m,n+1)}{2}$.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

23. (Original) The apparatus of claim 20, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m is an even integer and n is an odd integer, the infrared intensity corresponding to the location (m,n) is given by $IR = X(m,n)$, the red intensity corresponding to the location (m,n) is given by $R = X(m-1,n)$, the green intensity corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$, and the blue intensity corresponding to the location (m,n) is given by

$$B = \frac{X(m-1,n) + X(m+1,n)}{2}.$$

24. (Original) The apparatus of claim 20, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding to the location (m,n) is given by $R = X(m,n)$, the green intensity corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the blue intensity corresponding to the location (m,n) is given by

$$B = \frac{X(m-1,n-1) + X(m+1,n+1) + X(m+1,n-1) + X(m-1,n+1)}{4}.$$

25.    (Canceled)

26.    (Currently Amended) An [[The]] apparatus ~~of claim 25~~ comprising:

a complementary metal-oxide semiconductor (CMOS) sensor to capture an array

of pixel data; and

a color filter array (CFA) to pass selected wavelength ranges to respective pixel

locations of the CMOS sensor according to a predetermined pattern, wherein the

wavelength ranges include at least infrared wavelengths for one or more pixel locations

wherein the predetermined pattern comprises:

| B  | R | B  | R |
|----|---|----|---|
| IR | G | IR | G |
| B  | R | B  | R |
| IR | G | IR | G |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information.

27.    (Original)  The apparatus of claim 26, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the green intensity corresponding to the

location (m,n) is given by

$$G = \frac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n-1) + X(m+1,n+1)}{4}, \text{ and the blue}$$

intensity corresponding to the location (m,n) is given by $B = X(m,n)$.

28.    (Original)  The apparatus of claim 26, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by

$$IR = \frac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}, \text{ the red intensity}$$

corresponding to the location (m,n) is given by $R = X(m,n)$, the green intensity

corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the

blue intensity corresponding to the location (m,n) is given by

$$B = \frac{X(m,n-1) + X(m,n+1)}{2}.$$

29.    (Original)  The apparatus of claim 26, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an even integer and n is an odd integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = (m,n)$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$,

the green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, and the blue intensity corresponding to the location (m,n)

is given by $B = \dfrac{X(m-1,n) + X(m+1,n)}{2}$.

      30.    (Original)  The apparatus of claim 26, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the green intensity corresponding to the

location (m,n) is given by $G = X(m,n)$, and the blue intensity corresponding to the

location (m,n) is given by

$B = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$.

      31.    (Currently Amended)  An [[The]] apparatus ~~of claim 25~~ comprising:

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

a complementary metal-oxide semiconductor (CMOS) sensor to capture an array of pixel data; and

a color filter array (CFA) to pass selected wavelength ranges to respective pixel locations of the CMOS sensor according to a predetermined pattern, wherein the wavelength ranges include at least infrared wavelengths for one or more pixel locations wherein the predetermined pattern comprises:

| IR | R  | IR | B  |
|----|----|----|----|
| G  | IR | G  | IR |
| IR | B  | IR | R  |
| G  | IR | G  | IR |

where R indicates red intensity information, G indicates green intensity information, B indicates blue intensity information and IR indicates infrared intensity information.

32.     (Original)  The apparatus of claim 31, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = X(m,n)$, and the green intensity corresponding to the location (m,n) is given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and further wherein if the pixel at location (m,n-1) is red, the blue intensity corresponding to the location (m,n) is given by $B = X(m,n+1)$ and the red intensity corresponding to the location (m,n) is given by

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

$R = X(m, n-1)$, and if the pixel at location (m,n-1) is blue, the red intensity

corresponding to the location (m,n) is given by $R = X(m, n+1)$ and the blue intensity

corresponding to the location (m,n) is given by $B = X(m, n-1)$.

33.    (Original)  The apparatus of claim 31, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = \dfrac{X(m-1, n) + X(m+1, n) + X(m, n-1) + X(m, n+1)}{4}$ and

green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m-1, n-1) + X(m+1, n-1) + X(m-1, n+1) + X(m+1, n+1)}{4}$ and further wherein

if the pixel at location (m,n) is red, the blue intensity corresponding to the location (m,n)

is given by $B = \dfrac{X(m-2, n) + X(m+2, n) + X(m, n-2) + X(m, n+2)}{4}$ and the red

intensity corresponding to the location (m,n) is given by $R = X(m, n)$, and if the pixel at

location (m,n) is blue, the red intensity corresponding to the location (m,n) is given by

$B = X(m, n)$ and the blue intensity corresponding to the location (m,n) is given by

$R = \dfrac{X(m-2, n) + X(m+2, n) + X(m, n-2) + X(m, n+2)}{4}$.

34.    (Original)  The apparatus of claim 31, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an even integer and n is an odd integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = \dfrac{X(m, n-1) + X(m, n+1) + X(m-1, n) + X(m+1, n)}{4}$ and

green intensity corresponding to the location (m,n) is given by $G = X(m, n)$ and further

wherein if the pixel at location (m-1,n-1) is red, the blue intensity corresponding to the

location (m,n) is given by $B = \dfrac{X(m-1, n+1) + X(m+1, n-1)}{2}$ and the red intensity

corresponding to the location (m,n) is given by $R = \dfrac{X(m-1, n-1) + X(m+1, n+1)}{2}$, and

if the pixel at location (m-1,n-1) is blue, the red intensity corresponding to the location

(m,n) is given by $R = \dfrac{X(m-1, n+1) + (m+1, n-1)}{2}$ and the blue intensity corresponding

to the location (m,n) is given by $B = \dfrac{X(m-1, n-1) + X(m+1, n+1)}{2}$.


     35.    (Original)  The apparatus of claim 31, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both even integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = X(m, n)$ , and the green intensity corresponding to the location (m,n) is

given by $G = \dfrac{X(m, n-1) + X(m, n+1)}{2}$ and further wherein if the pixel at location (m-

1,n) is red, the blue intensity corresponding to the location (m,n) is given by

$B = X(m+1, n)$ and the red intensity corresponding to the location (m,n) is given by

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

$R = X(m-1,n)$, and if the pixel at location (m-1,n+1) is blue, the red intensity

corresponding to the location (m,n) is given by $R = X(m+1,n)$ and the blue intensity

corresponding to the location (m,n) is given by $B = X(m-1,n)$.

36.    (Currently Amended)  An [[The]] apparatus of claim 25 comprising:

a complementary metal-oxide semiconductor (CMOS) sensor to capture an array

of pixel data; and

a color filter array (CFA) to pass selected wavelength ranges to respective pixel

locations of the CMOS sensor according to a predetermined pattern, wherein the

wavelength ranges include at least infrared wavelengths for one or more pixel locations

the predetermined pattern comprises:

| B | R | B | R |
|---|---|---|---|
| G | IR | G | IR |
| B | R | B | R |
| G | IR | G | IR |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information.

37.    (Original)  The apparatus of claim 36, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n+1) + X(m+1,n-1)}{4}$, the red

intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m,n-1) + X(m,n+1)}{2}$,

the green intensity corresponding to the location (m,n) is given by

$G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the blue intensity corresponding to the location (m,n)

is given by $B = X(m,n)$.

38.    (Original)  The apparatus of claim 36, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding

to the location (m,n) is given by $R = X(m,n)$, the green intensity corresponding to the

location (m,n) is given by

$G = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$, and the blue

intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m,n-1) + X(m,n+1)}{2}$.

39.    (Original)  The apparatus of claim 36, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an even integer and n is an odd integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding

to the location (m,n) is given by

$$R = \frac{X(m-1,n-1) + X(m+1,n-1) + X(m+1,n+1) + X(m+1,n-1)}{4}$$, the green intensity

corresponding to the location (m,n) is given by $G = X(m,n)$, and the blue intensity

corresponding to the location (m,n) is given by $B = \dfrac{X(m-1,n) + X(m+1,n)}{2}$.

40.    (Original)  The apparatus of claim 36, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = X(m,n)$, the red intensity corresponding to the location (m,n) is given by

$R = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the green intensity corresponding to the location (m,n) is

given by $G = \dfrac{X(m,n+1) + X(m,n-1)}{2}$, and the blue intensity corresponding to the

location (m,n) is given by

$$B = \frac{X(m-1,n-1) + X(m+1,n+1) + X(m-1,n+1) + X(m+1,n-1)}{4}$$.

41.    (Currently Amended)  An [[The]] apparatus of claim 25 comprising:

a complementary metal-oxide semiconductor (CMOS) sensor to capture an array of pixel data; and

a color filter array (CFA) to pass selected wavelength ranges to respective pixel locations of the CMOS sensor according to a predetermined pattern, wherein the wavelength ranges include at least infrared wavelengths for one or more pixel locationswherein the predetermined pattern comprises:

| B | G | B | G[[B]] |
|---|---|---|---|
| IR | R | IR | R |
| B | G | B | G |
| IR | R | IR | R |

where R indicates red intensity information, G indicates green intensity information, B indicates blue intensity information and IR indicates infrared intensity information.


42.　　(Original)　The apparatus of claim 41, wherein for a pixel in the predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m and n are both odd integers, the infrared intensity corresponding to the location (m,n) is given by $IR = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, the red intensity corresponding to the location (m,n) is given by $R = \dfrac{X(m-1,n-1) + X(m-1,n+1) + X(m+1,n+1) + X(m+1,n-1)}{4}$, the green intensity corresponding to the location (m,n) is given by

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

$G = \dfrac{X(m, n-1) + X(m, n+1)}{2}$, and the blue intensity corresponding to the location (m,n)

is given by $B = X(m, n)$.

43.     (Original)  The apparatus of claim 41, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an odd integer and n is an even integer, the infrared intensity corresponding to the

location (m,n) is given by

$IR = \dfrac{X(m-1, n-1) + X(m+1, n-1) + X(m-1, n+1) + X(m+1, n+1)}{4}$, the red intensity

corresponding to the location (m,n) is given by $R = \dfrac{X(m-1, n) + X(m+1, n)}{2}$, the green

intensity corresponding to the location (m,n) is given by $G = X(m, n)$, and the blue

intensity corresponding to the location (m,n) is given by $B = \dfrac{X(m, n-1) + X(m, n+1)}{2}$.

44.     (Original)  The apparatus of claim 41, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

is an even integer and n is an odd integer, the infrared intensity corresponding to the

location (m,n) is given by $IR = X(m, n)$, the red intensity corresponding to the location

(m,n) is given by $R = X(m-1, n)$, the green intensity corresponding to the location (m,n)

is given by $G = \dfrac{X(m-1,n-1) + X(m+1,n-1) + X(m-1,n+1) + X(m+1,n+1)}{4}$, and the

blue intensity corresponding to the location (m,n) is given by

$B = \dfrac{X(m-1,n) + X(m+1,n)}{2}$.

45.     (Original)  The apparatus of claim 41, wherein for a pixel in the

predetermined pixel pattern in a location (m,n) where m indicates a row and n indicates a

column and X(m,n) is the intensity corresponding to the pixel in the location (m,n), if m

and n are both odd integers, the infrared intensity corresponding to the location (m,n) is

given by $IR = \dfrac{X(m,n-1) + X(m,n+1)}{2}$, the red intensity corresponding to the location

(m,n) is given by $R = X(m,n)$, the green intensity corresponding to the location (m,n) is

given by $G = \dfrac{X(m-1,n) + X(m+1,n)}{2}$, and the blue intensity corresponding to the

location (m,n) is given by

$B = \dfrac{X(m-1,n-1) + X(m+1,n+1) + X(m+1,n-1) + X(m-1,n+1)}{4}$.

46-70. (Canceled)

71.     (Currently Amended)  The sensor of claim 72 [[70]] wherein red intensity

values, green intensity values, blue intensity values and infrared intensity values are

capture substantially contemporaneously.

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

72.    (Currently Amended) <u>A sensor that receives pixel data representing color intensity values for a plurality of pixel locations of a scene to be captured according to a predetermined pattern, wherein one or more of the color intensity values corresponds to intensity of light having infrared wavelengths</u> ~~The apparatus of claim 70~~ wherein the predetermined pattern comprises:

| B | R | B | R |
|---|---|---|---|
| IR | G | IR | G |
| B | R | B | R |
| IR | G | IR | G |

where R indicates red intensity information, G indicates green intensity information, B indicates blue intensity information and IR indicates infrared intensity information.


73.    (Currently Amended) <u>A sensor that receives pixel data representing color intensity values for a plurality of pixel locations of a scene to be captured according to a predetermined pattern, wherein one or more of the color intensity values corresponds to intensity of light having infrared wavelengths</u> wherein the predetermined pattern comprises:

| IR | R | IR | B |
|---|---|---|---|
| G | IR | G | IR |
| IR | B | IR | R |

Application No. 10/664,023  
Amendment dated April 24, 2007  
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X  
Examiner Madden, Gregory Vincent  
TC/A.U. 2622

| G | IR | G | IR |
|---|----|---|----|

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information.

74.    (Currently Amended) A sensor that receives pixel data representing color

intensity values for a plurality of pixel locations of a scene to be captured according to a

predetermined pattern, wherein one or more of the color intensity values corresponds to

intensity of light having infrared wavelengths wherein the predetermined pattern

comprises:

| B | R  | B | R  |
|---|----|---|----|
| G | IR | G | IR |
| B | R  | B | R  |
| G | IR | G | IR |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information.

75.    (Currently Amended) A sensor that receives pixel data representing color

intensity values for a plurality of pixel locations of a scene to be captured according to a

predetermined pattern, wherein one or more of the color intensity values corresponds to

intensity of light having infrared wavelengths wherein the predetermined pattern

comprises:

Application No. 10/664,023
Amendment dated April 24, 2007
Response to Office Action of March 19, 2007

Atty. Docket No. 42P15466X
Examiner Madden, Gregory Vincent
TC/A.U. 2622

| B | G | B | G[[B]] |
|---|---|---|---|
| IR | R | IR | R |
| B | G | B | G |
| IR | R | IR | R |

where R indicates red intensity information, G indicates green intensity information, B

indicates blue intensity information and IR indicates infrared intensity information.


76-104. (Canceled)